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Neumann

[11] **4,360,128**

[45] **Nov. 23, 1982**

[54] **BEVERAGE DISPENSER HAVING TIMED OPERATING PERIOD RESPONSIVE TO RESERVOIR QUANTITY**

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[73] Assignee: **Reynolds Products Inc.**, Schaumburg, Ill.

[21] Appl. No.: **173,271**

[22] Filed: **Jul. 29, 1980**

[51] **Int. Cl.**[3] **A47J 31/46**; G04C 23/38

[52] **U.S. Cl.** ..... **222/26**; 99/281; 219/333; 219/433; 219/518; 222/64; 222/641; 222/146 HE; 340/618

[58] **Field of Search** ..... 222/23, 25, 58, 26, 222/64, 65, 66, 70, 146 HE; 99/280, 281, 285, 288; 219/214, 322, 333, 433, 518; 364/478, 479, 567, 568, 569; 414/21; 340/612, 613, 614, 618, 620, 623, 624, 625

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[57] **ABSTRACT**

A beverage dispenser in which a sensor provides an output corresponding to the level of the beverage in a storage reservoir from which the beverage is dispensed. In response to user actuation a dispensing valve is enabled for such a time interval, determined in accordance with the output of the sensor, as to compensate for variations in flow rate due to variations in the beverage level in the reservoir. The level sensor output is also used to control a level-indicating display and to disable the reservoir heater when the reservoir is empty. Preferably the sensor is a strain gauge adhered to the surface of a relatively thin resilient beam which supports a portion of the reservoir.

9 Claims, 5 Drawing Figures

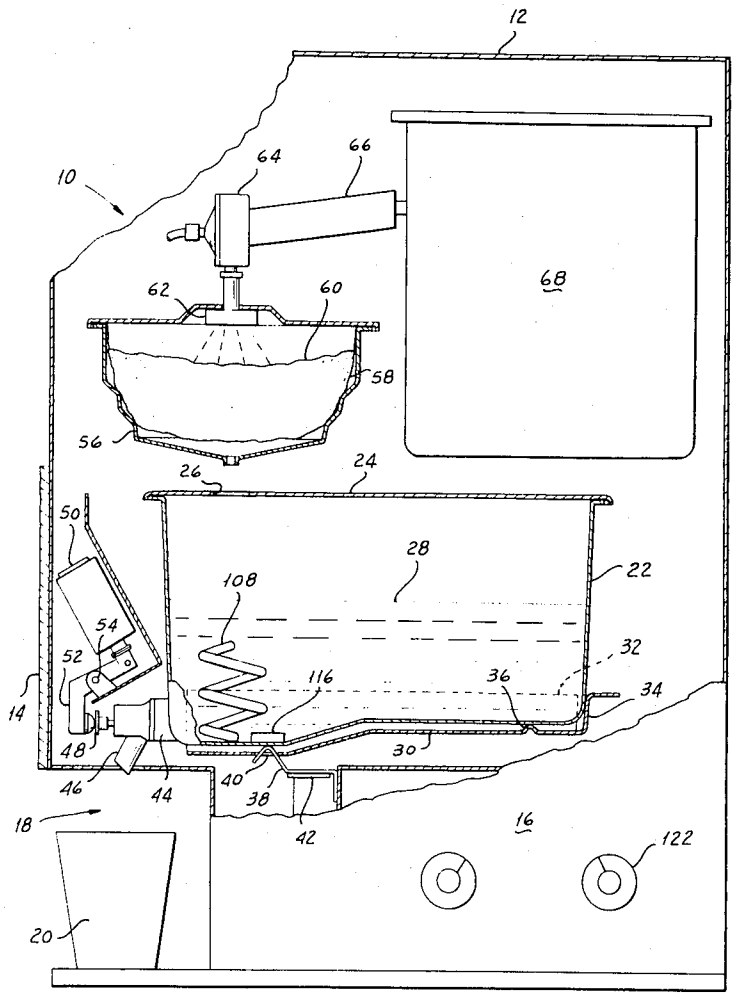


Fig 1

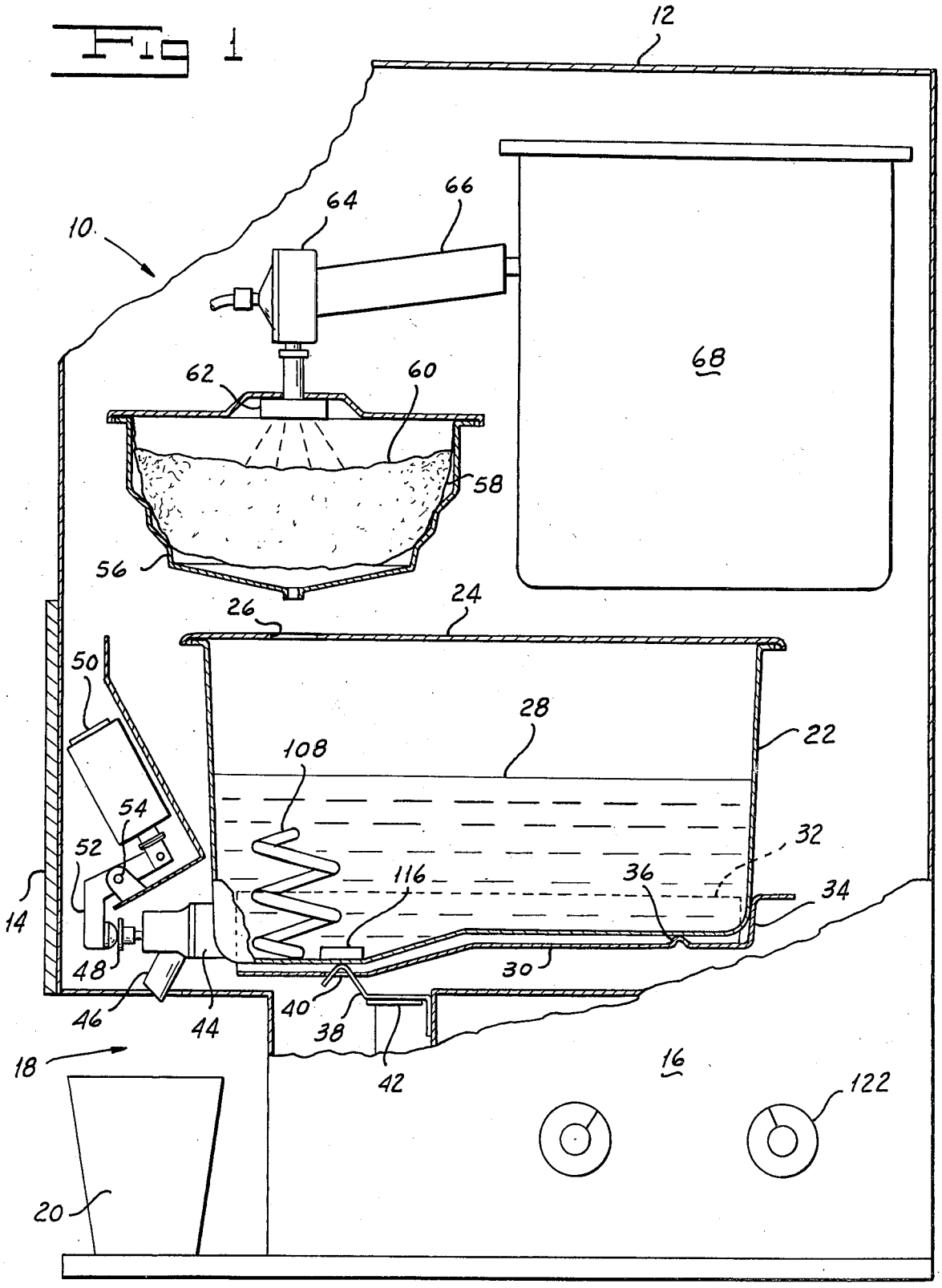
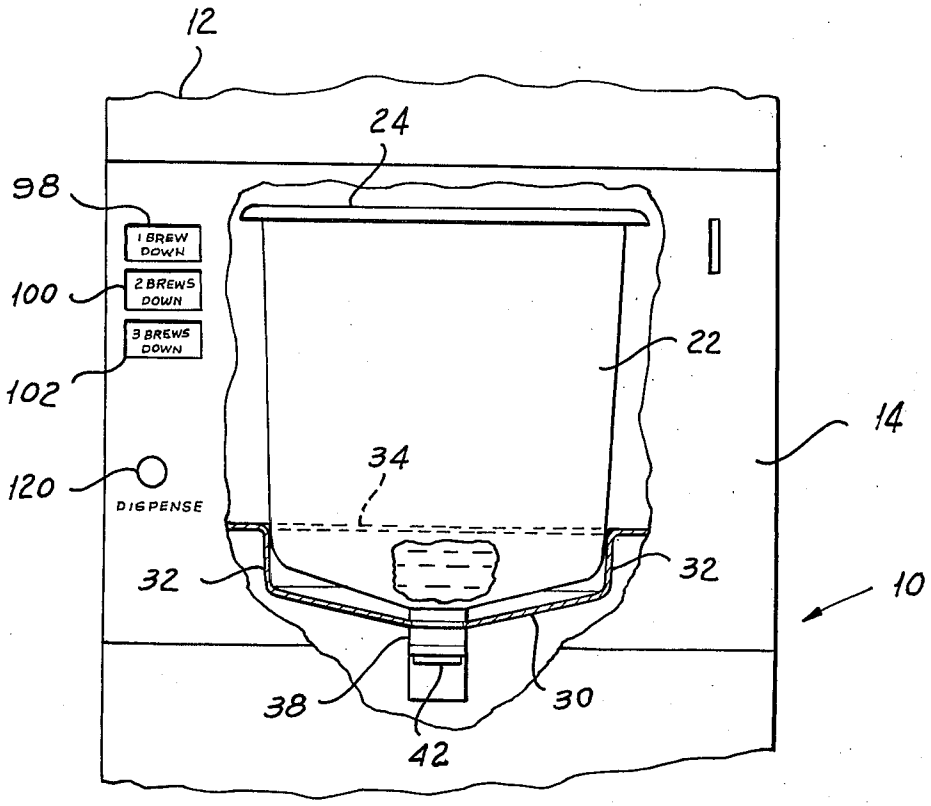
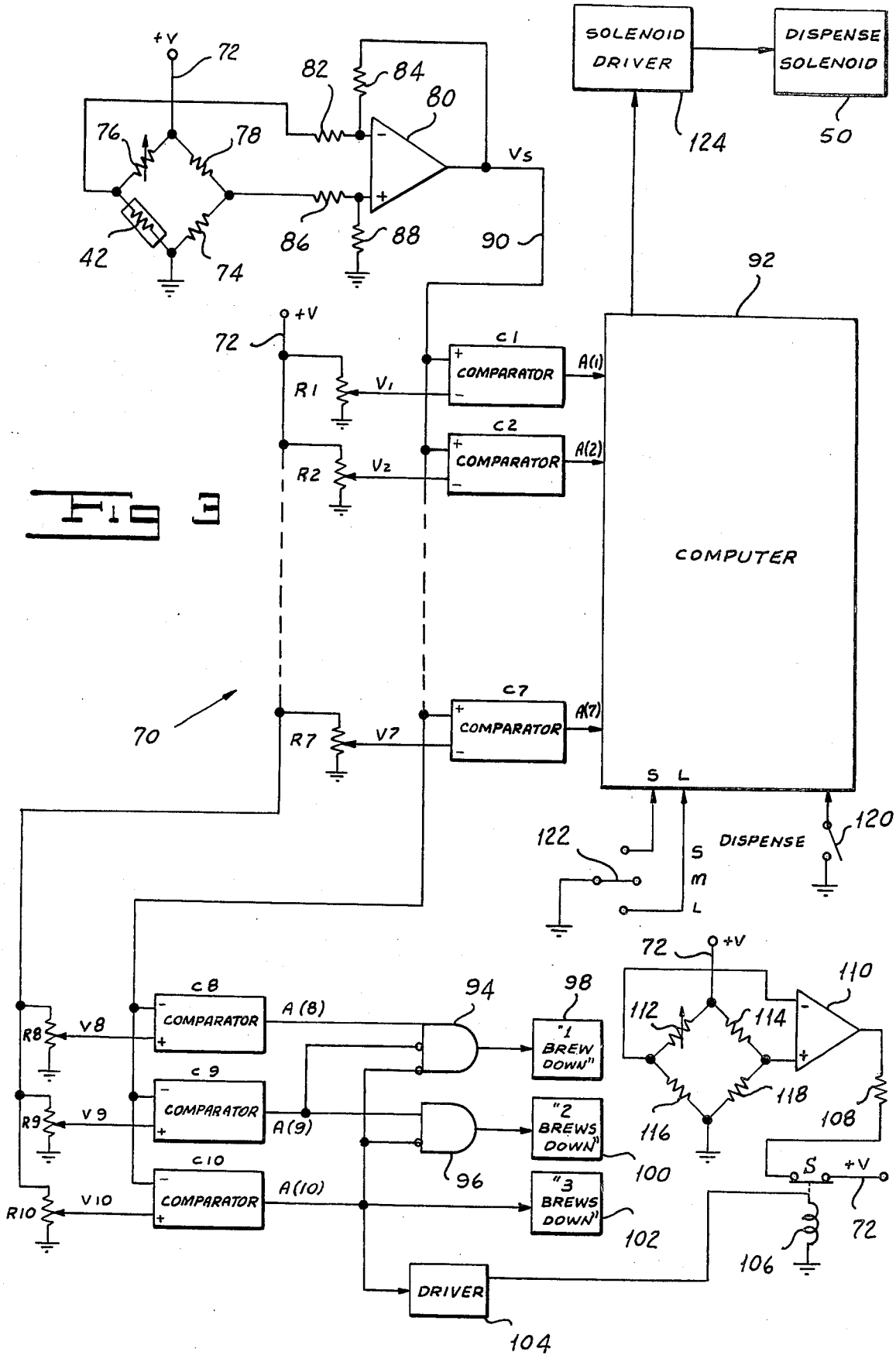

12
10
64
66
68
62
60
58
56
26
24
50
28
22
108
54
52
32
116
36
34
14
48
30
46
44
40
38
42
18
16
122
20

Fig 2



I	TIME (I)		
	5 oz.	6 oz.	10 oz.
1	2.8	3.3	5.6
2	2.8	3.3	5.6
3	2.9	3.4	5.8
4	3.1	3.65	6.2
5	3.3	3.9	6.6
6	3.6	4.3	7.2
7	3.9	4.65	7.9
8	4.3	5.1	8.6

Fig 5


+V
72
82
84
80
76
78
Vs
42
74
86
88
90
SOLENOID DRIVER
DISPENSE SOLENOID
124
50
92
C1
COMPARATOR
A(1)
R1
V1
C2
COMPARATOR
A(2)
R2
V2
COMPUTER
70
C7
COMPARATOR
A(7)
R7
V7
S L
DISPENSE
120
122
S
m
L
C8
COMPARATOR
A(8)
R8
V8
C9
COMPARATOR
A(9)
R9
V9
C10
COMPARATOR
A(10)
R10
V10
94
96
98
"1 BREW DOWN"
"2 BREWS DOWN"
100
"3 BREWS DOWN"
102
DRIVER
104
110
112
114
116
118
108
S
106

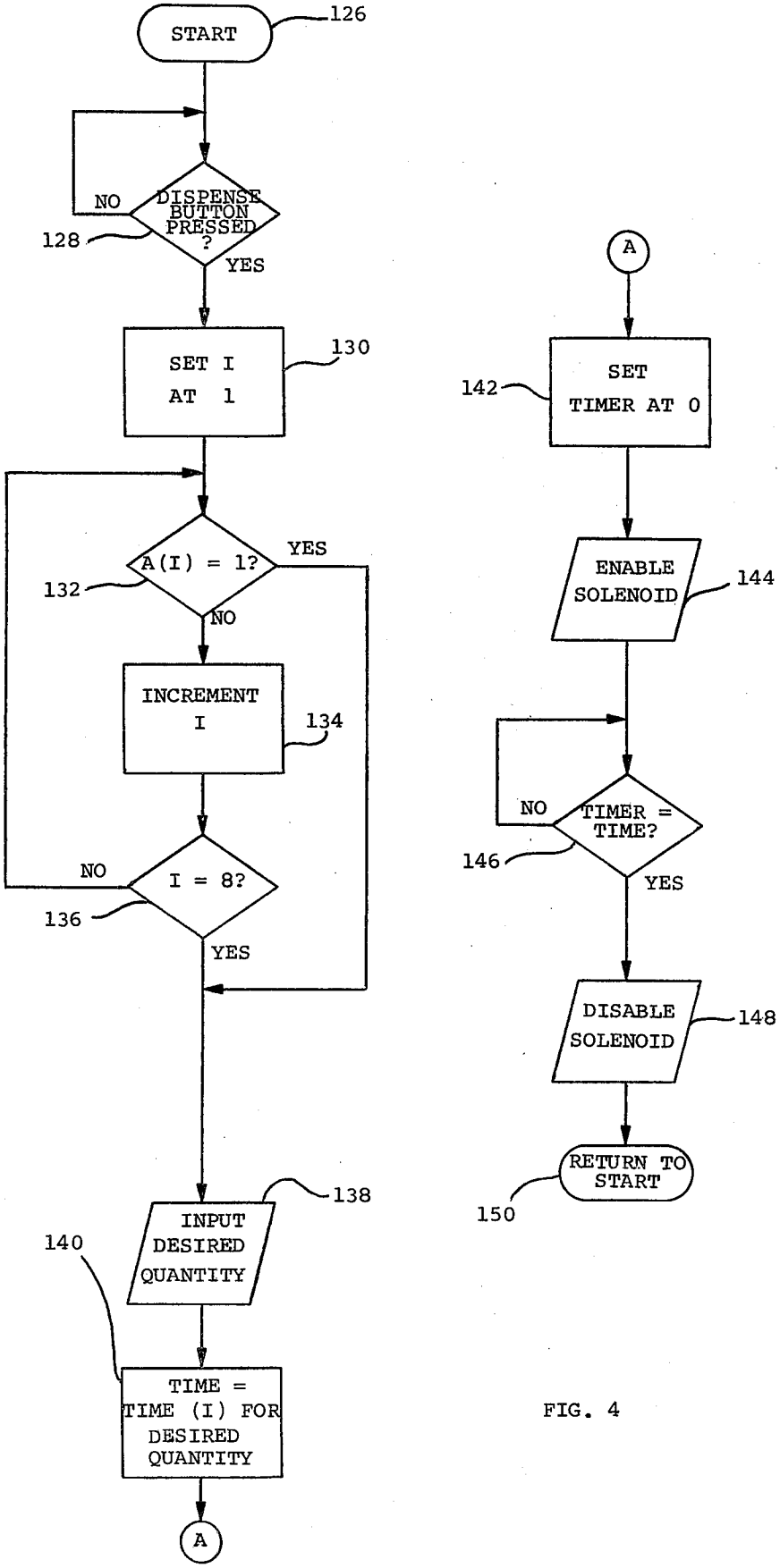

START
126
DISPENSE BUTTON PRESSED ?
NO
YES
128
SET I AT 1
130
A(I) = 1?
YES
NO
132
INCREMENT I
134
I = 8?
NO
YES
136
INPUT DESIRED QUANTITY
138
140
TIME = TIME (I) FOR DESIRED QUANTITY
A
A
SET TIMER AT 0
142
ENABLE SOLENOID
144
TIMER = TIME?
NO
YES
146
DISABLE SOLENOID
148
RETURN TO START
150

FIG. 4

BEVERAGE DISPENSER HAVING TIMED OPERATING PERIOD RESPONSIVE TO RESERVOIR QUANTITY

BACKGROUND OF THE INVENTION

Apparatus for dispensing coffee or other beverage in response to the deposit of a coin or the actuation of a switch are well known in the art. In one type of such apparatus, a storage pan or reservoir is used to hold the previously prepared beverage prior to dispensing and to dispense the beverage from the storage pan through a controllable valve.

Various expedients have been employed in the prior art to control the amount of beverage delivered to a user. In some vending machines, the dispense valve is opened by actuation of a push-button switch that becomes operable if a coin is deposited. The valve does not close until the button is released. If a customer is able to position a second cup with one hand after the first cup is filled while keeping the button depressed with the other hand, he can obtain two or more cups for the price of only one. In other systems, the dispense valve is energized for a fixed time interval to dispense the desired amount of beverage. This method is highly unsatisfactory, however, since the flow rate is dependent on the pressure head from the reservoir, which varies directly with the level of beverage in the reservoir.

Still other systems employ a positive displacement technique in which a first valve is actuated to fill a chamber with beverage from the reservoir and a second valve then actuated to fill the cup from the chamber. While these systems insure the dispensing of a controlled amount of beverage irrespective of the level in the reservoir, they do not permit ready adjustment to dispense different amounts of beverage.

SUMMARY OF THE INVENTION

One of the objects of my invention is to provide a beverage dispenser which accurately dispenses a controlled amount of a beverage.

Another object of my invention is to provide a beverage merchandiser which prevents multiple dispensations of a beverage when the cost of only a single delivery has been deposited.

Yet another object of my invention is to provide a beverage dispenser in which the amount of beverage dispensed does not depend on the level of the beverage in a storage reservoir.

Still another object of my invention is to provide a beverage dispenser which is readily adjustable to dispense different desired amounts of beverage.

Another object of my invention is to provide a beverage dispenser in which the number of moving parts is minimized.

Other and further objects of my invention will be apparent from the following description.

In general, my invention contemplates a beverage dispenser in which a sensor provides an output corresponding to the level of the beverage in a storage reservoir from which the beverage is dispensed. In response to user actuation a dispensing valve is enabled for such a time interval, determined in accordance with the output of the sensor, as to compensate for variations in flow rate due to variations in the beverage level in the reservoir. Preferably, the sensor is a strain gauge adhered to the surface of a relatively thin resilient beam which supports a portion of the reservoir.

My invention further contemplates apparatus in which the level sensor output is used to control a level-indicating display and to disable the reservoir heater when the reservoir is empty.

BRIEF DESCRIPTION OF THE DRAWINGS

In the accompanying drawings which form part of the instant specification and which are to be read in conjunction therewith and in which like reference numerals indicate like parts in the various views:

FIG. **1** is a fragmentary side elevation of my beverage dispenser, with parts shown in section.

FIG. **2** is a fragmentary front elevation of the beverage dispenser shown in FIG. **1**, illustrating the front display panel and strain-gauge sensor associated with the beverage storage pan.

FIG. **3** is a schematic diagram of a control circuit for the beverage dispenser shown in FIG. **1**.

FIG. **4** is a flow chart illustrating a program which may be followed by the microcomputer of the control circuit shown in FIG. **4**.

FIG. **5** is a table of the various time bases associated with various desired amounts of beverage and sensed levels of beverage in the storage pan of the dispenser shown in FIG. **1**.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to the drawings, my beverage dispenser, indicated generally by the reference numeral **10**, is enclosed by a housing **12** having a front display panel **14** and a side control panel **16**. The housing **12** is formed with a recess **18** at the lower end of the front panel in which a cup **20** may be placed to receive a dispensed beverage.

A storage pan **22** holds a supply of a beverage **28** such as coffee supplied to the pan through an aperture **26** formed in a top cover **24**. Storage pan **22** rests on a transversely extending ridge **36** formed in a support **30** near the rear end thereof. Side flanges **32** and a rear flange **34** on the support **30** confine the storage pan **22** laterally and rearwardly without bearing any of the weight of the pan **22**. The front end of the storage pan **22** rests on the inverted-V-shaped front end of a resilient metal strip or arm **38** secured at the rear end thereof to a portion of the housing **12** and extending through an aperture **40** formed in the support **30**. A strain gauge **42** secured to the lower surface of the resilient arm **38** with its gauge axis running fore and aft relative to the dispenser **10** senses the compressional, or negative, strain in the lower surface of the arm **38** resulting from the weight of the storage pan **22** and the beverage **28** contained therein.

The cup **20** receives the beverage **28** through a dispensing valve **44** located at the lower front end of the storage pan **22**. Actuation of a solenoid **50** causes lever arm **52** to rotate about its pivot **54**, pressing the actuator button **48** of the valve **44** inwardly to allow the beverage **28** to flow through the spout **46** and into cup **20**.

The beverage **28** may be coffee which is supplied to the storage pan **22** from a brew basket **56** disposed above the aperture **26** in the top cover **24**. As is known in the art, brew basket **56** receives a replaceable filter cup **58** partially filled with ground coffee **60** and receives hot water from a spray discharge head **62** disposed at the top of the brew basket. A spray discharge

valve **64** controls the flow of hot water to the brew basket from a hot water tank **68** through a discharge line **66**. While the brew basket **56**, hot water tank **68** and associated elements do not per se form a part of my invention, a detailed description of an automatic beverage brewer containing these elements may be found in U.S. Pat. No. 3,443,508, issued to D. S. Reynolds et al.

In FIG. **3**, I show the control circuit, indicated generally by the reference numeral **70**, for my beverage dispenser. I connect the electrical terminals of the strain gauge **42** respectively to ground and to one terminal of an adjustable resistor **76**, the other terminal of which I connect to a line **72** leading from a source of positive DC potential. Gauge **42** and resistor **76** make up two legs of a bridge, the other two legs of which are formed by resistors **74** and **78**. Respective resistors **82** and **86** connect the output terminals of the bridge to the inverting and noninverting input terminals of a high-gain operational amplifier **80**. Respective resistors **84** and **88** couple the inverting and noninverting inputs of amplifier **80** to the amplifier output and to ground respectively.

Amplifier **80** provides an output v_s which is proportional to the difference between the potentials across the strain gauge **42** and the resistor **74**. Resistor **76** is so adjusted that amplifier **80** provides a zero output when the pan **22** is empty. As more beverage **28** is supplied to the pan **22**, the increased pressure on the resilient strip **38** causes an increased compressive, or negative, strain on the lower surface of the strip, in turn decreasing the electrical resistance of the strain gauge **42**. As a result, strain gauge **42** supplies a reduced potential to the inverting input of amplifier **80**, thereby resulting in an increasingly positive amplifier output.

I convert the output of amplifier **80**, which appears as an analog signal on line **90**, to a series of quantized signals indicating in a discrete fashion the extent to which the pan **22** is filled. To this end, I compare the signal v_s with a plurality of reference potentials v_1 to v_{10} derived from respective potentiometers R1 to R10 coupled between the DC voltage line **72** and ground. Respective comparators C1 to C10 each receive one input from line **90** and the other input as one of the comparison potentials v_1 to v_{10}. Comparators C1 to C7 each provide a **1**, or high, output whenever the potential v_s on line **90** exceeds the comparison potential but provide a zero, or low, output otherwise. Comparators C8 to C10 on the other hand each provide a low output when v_s exceeds the comparison potential and a high output otherwise.

Potentiometers R1 to R7 are set to provide potentials v_1 to v_7 spaced in approximately equal steps between a potential v_1 corresponding to a nearly full storage pan and a potential v_7 corresponding to a nearly empty storage pan. Thus, when storage pan **22** is filled to its capacity of approximately 30 cups, none of the outputs of the comparators C1 through C7 are low. On the other hand, when the storage pan **22** is nearly empty, all of the comparator outputs are low. Intermediate levels of beverage **28** in the storage pan **22** result in an intermediate number of the comparators C1 to C7 providing low outputs.

Potentiometers R8, R9 and R10 are set to provide potentials corresponding to the output of amplifier **80** when the storage pan **22** is two-thirds full, one-third full and nearly empty, respectively. Thus, when the storage pan **22** is two-thirds full or more, that is, containing 20 or more cups of coffee, the potential v_s exceeds each of the potentials v_8, v_9 and v_{10}. As a result, each of the comparators C8, C9 and C10 provides a zero output. When the level of the beverage **28** in the storage pan **22** drops below the level corresponding to two-thirds full, v_8 then exceeds v_s, resulting in a high output from comparator C8. An AND circuit **94** responsive to the output of comparator C8 then provides a high output to energize an indicator light **98** on the front panel of the dispenser **10** indicating that the level of the beverage **28** is 10 cups, or one brew, down from its initial level.

When the level of the beverage **28** drops below one-third full, or 10 cups, v_9 also exceeds v_s, resulting in a **1** or high output from comparator C9 as well as from C8. The high output of comparator C9 is applied to an inverting input of AND circuit **94** to disable the "one brew down" indicator lamp **98**. At the same time, the output of comparator C9 is fed to another AND circuit **96**, the output of which energizes a "two brews down" indicator lamp **100** on the front panel **14** below indicator lamp **98**.

When, eventually, the level of the beverage **28** in storage pan **22** drops to a near empty level, all three potentials v_8, v_9 and v_{10} exceed the strain gauge potential v_s. As a result, all three comparators C8, C9 and C10 provide zero or low outputs. The zero output of comparator C10 feeds inverting inputs of AND circuits **94** and **96** to disable respective indicator lights **98** and **100** and, in addition, energizes a "three brews down" indicator lamp **102** disposed on the front panel **14** below lamps **98** and **100**.

In the normal operation of the dispenser **10**, the temperature of the beverage **28** in the storage pan **22** is controlled by a resistive heating coil **108** disposed in the pan **22** by a thermistor **116** also disposed in the pan **22**. Thermistor **116** is coupled in a bridge circuit between ground and one terminal of an adjustable resistor **112**, the other terminal of which is coupled to DC voltage line **72**. Resistors **114** and **118** form the other legs of the bridge. The bridge output terminals are coupled respectively to the inverting and to the noninverting inputs of a differential amplifier **110**. I couple the heating element **108** between the output of amplifier **110** and one terminal of a normally closed relay-controlled switch S, the other terminal of which I couple to line **72**.

In the normal operation of the heating control circuit, any increase in the temperature of the beverage **28** will result in a corresponding decrease in the resistance of thermistor **116**, thereby resulting in a lower potential being applied to the inverting input of amplifier **110**. As a result, the output of amplifier **110** rises, causing the potential applied to the heating coil **108** to drop, thereby leading eventually to a suitably lower temperature of the beverage **28**. Variable resistor **112** is set at a suitable level to establish a proper temperature of the beverage **28** in the pan **22**.

In response to the change of the output of comparator C10 to zero when the beverage reaches a near empty level in the pan **22**, a driver circuit **104** energizes a relay **106**, opening the switch S and thereby disabling the heating element **108**.

I couple the outputs of comparators C1 to C7 to a microcomputer **92** such as an Intel 8048, sold by the Intel Corporation of Santa Clara, Calif., and described in the Intel user's manual entitled "MCS-48 Family of Single Chip Microcomputers" (1978). FIG. **4** is a flowchart illustrating a program which may be followed by the computer **92** in generating suitable time bases for controlling the dispensing of beverage **28** from the stor-

age pan **22**. After the program starts (block **126**), it waits (block **128**) for a normally open dispense button **120**, coupled between a normally high input to computer **92** and ground and mounted on the front panel **14**, to be closed.

After the dispense button **120** is pushed, the program sets an index I at 1 (block **130**) and interrogates the corresponding comparator to determine whether the output of that comparator is one, indicating that the storage pan **22** is filled at least to the level set by the corresponding one of potentiometers R1 to R7 (block **132**). If the comparator output is 1, the program leaves the loop. Otherwise, the program increments the index I by 1 (block **134**) and asks (block **136**) whether the index has now reached the number 8, indicating that there are no more comparators to be checked. If the index I is still 7 or less, the program returns to block **132** to interrogate the next comparator to determine whether its output is 1. The program continues along the loop comprising blocks **132** to **136** until either a comparator with a 1 output is found or the index I reaches 8. Thus, when the program leaves the loop the index I will be set at a number between 1 and 8 corresponding to the "zone" to which the storage pan **22** is filled.

Next, the program interrogates the outputs of a three-position selector switch **122** which may be set to select a small (5 oz.), medium (6 oz.) or large (10 oz.) quantity of beverage to be dispensed. Switch **122**, which may be mounted on the side panel **16**, grounds a normally high first input to computer **92** if moved to the "small" position and grounds a second normally high input to computer **92** if moved to the "large" position. Otherwise, both outputs remain high. After determining the desired quantity of beverage to be dispensed, the program selects a suitable time base (block **140**) from an internally stored array of time bases shown in tabular form in FIG. **5**. As is apparent from the table, the time base selected depends both on the value of I, indicating the present level of the tank **22**, and the amount of beverage to be dispensed.

The program next sets a timer (not shown) internal to computer **92** to zero to mark the beginning of the dispense sequence, and thereafter provides a suitable signal to a solenoid driver **124** to energize the dispense solenoid **50** (block **144**). Energization of solenoid **50** causes the beverage **28** to be dispensed through the spout **46** in the manner described above. When the elapsed time as measured by the timer output equals the previously selected time base (block **146**), the program disables (block **148**) the solenoid **50**, thereby terminating the dispensing sequence. Thereafter, the program returns (block **150**) to the starting block **126** to await the subsequent actuation of the dispense button **120**.

It will be seen that I have accomplished the objects of my invention. My beverage dispenser dispenses a controlled amount of a beverage and is readily adjustable to dispense different desired amounts of beverage. Further, the amount of the beverage dispensed does not depend on the level of the beverage in the storage reservoir. Finally, my beverage dispenser resists unauthorized attempts to obtain multiple dispensations of a beverage.

It will be understood that certain features and subcombinations are of utility and may be employed without reference to other features and subcombinations. This is contemplated by and is within the scope of my claims. It is further obvious that various changes may be made in details within the scope of my claims without departing from the spirit of my invention. It is, therefore, to be understood that my invention is not to be limited to the specific details shown and described.

Having thus described my invention, what I claim is:

1. Beverage dispensing apparatus including in combination a reservoir adapted to receive a beverage to be dispensed, means for sensing the amount of said beverage in said reservoir, means responsive to user actuation for dispensing said beverage from said reservoir, and means responsive to said sensing means for controlling the period of enablement of said dispensing means.

2. Beverage dispensing apparatus including in combination a reservoir adapted to receive a beverage to be dispensed, means for sensing the amount of said beverage in said reservoir, means responsive to user actuation for dispensing said beverage from said reservoir, means responsive to said sensing means for controlling the period of enablement of said dispensing means, means for heating the beverage contained in said reservoir, and means responsive to said sensing means for disabling said heating means.

3. Beverage dispensing apparatus including in combination a reservoir adapted to receive a beverage to be dispensed, means for sensing the amount of said beverage in said reservoir, means responsive to user actuation for dispensing said beverage from said reservoir, means responsive to said sensing means for controlling the period of enablement of said dispensing means, and means responsive to said sensing means for displaying the amount of said beverage in said reservoir.

4. Beverage dispensing apparatus including in combination a reservoir adapted to be filled to one of a plurality of ranges of levels with a beverage to be dispensed, means for supplying a predetermined amount of beverage to said reservoir, said ranges corresponding in extent to said predetermined amount, means for sensing the particular one of said ranges to which said reservoir is filled, and means responsive to said sensing means for displaying said sensed range.

5. Beverage dispensing apparatus including in combination a reservoir adapted to receive a beverage to be dispensed, sensing means for providing an output corresponding to the level of said beverage in said reservoir, means for dispensing said beverage from said reservoir, means for preselecting a desired amount of beverage to be dispensed, and means responsive to user actuation for enabling said dispensing means for a time interval determined in accordance with said preselected desired amount and the output of said sensing means.

6. Beverage dispensing apparatus including in combination a reservoir adapted to receive a beverage to be dispensed, a resilient beam positioned to support a portion of said reservoir at one end of said beam, a strain gauge adhered to a surface of said beam, means for dispensing said beverage from said reservoir, and means responsive to user actuation for enabling said dispensing means for a time interval determined in accordance with the output of said strain gauge.

7. Beverage dispensing apparatus including in combination a reservoir adapted to receive a beverage to be dispensed, a resilient beam positioned to support a portion of said reservoir at one end of said beam, said beam being relatively thin in the direction of bending under the weight of said reservoir, means for sensing strain in said beam, means for dispensing said beverage from said reservoir, and means responsive to user actuation for

enabling said dispensing means for a time interval determined in accordance with said sensed strain.

8. Beverage dispensing apparatus including in combination a reservoir adapted to receive a beverage to be dispensed, a resilient beam positioned to support a portion of said reservoir at one end of said beam, means for sensing strain in said beam, means for dispensing said beverage from said reservoir, and means responsive to user actuation for enabling said dispensing means for a time interval determined in accordance with said sensed strain.

9. Beverage dispensing apparatus including in combination a reservoir adapted to receive a beverage to be dispensed, a resilient member positioned to support a portion of said reservoir, means for sensing strain in said member, means for dispensing said beverage from said reservoir, and means responsive to user actuation for enabling said dispensing means for a time interval determined in accordance with said sensed strain.

* * * * *